Herbicide Injury in the Nursery and Landscape

Michael A. Schnelle
Professor,
Extension Ornamental Floriculture Specialist

Janet C. Cole
Professor, Nursery Management

Weed control is a major budgetary item in nursery and landscape maintenance programs. With escalating labor costs, chemical control is necessary when feasible to remain competitive. However, many problems are associated with herbicides in nursery and landscape settings. There is a relatively small pool of chemicals labeled for horticultural crops, since chemical companies realize only a small financial return from the limited size of the horticultural markets. Compound this problem with a variety of species often growing together in one bed, and problems arise in achieving proper selectivity.

Selective and Nonselective Weed Control

Herbicides are normally separated into two general categories: selective and nonselective herbicides. When applied correctly, many herbicides are selective. That is, only certain types of vegetation will be killed. Selective herbicides have the potential to become nonselective (soil sterilants) when deliberately or accidentally applied at high rates. In some cases, the manufacturer intended these chemicals to be used either selectively or nonselectively depending on the vegetation control desired.

Soil sterilants destroy all vegetation to which they are applied. Not all nonselective herbicides are soil sterilants. Chemicals such as glyphosate will kill all vegetation, but do not persist in the soil. The use of herbicides with a short-term residue is ideal in the landscape, since plants may be safely introduced shortly after brush, turf, etc. have been eliminated.

Selectivity is based on

- herbicide dosage
- chemical formulation
- placement of the herbicide
- temperature during and after application
- rainfall
- species present - both weeds and nontarget plants
- growth stage of weeds and desirable species

Recognizing Herbicide Injury

Leaf chlorosis, or yellowing of foliage, is a common symptom of herbicide injury in plants. The application of many chemicals on the market today results in photosynthesis being disrupted and later ceased. Without photosynthesis, plants yellow, fade, and quickly display chlorosis. Often, soil-applied herbicides are responsible for this type of symptom. Unfortunately, chlorosis may also be caused by a number of other factors, with poor nutrition being a major contributor. Therefore, herbicides are often overlooked as the cause of yellowing. Nutrient deficiencies rarely result in rapid death of plants that many herbicides are capable of producing. See OSU Fact Sheet EPP-7644, Chlorosis of Foliage of Trees, Shrubs, and Lawn Grasses.

Herbicide-induced chlorosis differs from nutritional chlorosis by a bright yellow to white interveinal space contrasted with sharply defined secondary bright green veins. Nutritional chlorosis, however, displays a shaded or gradual fading of green from the yellow interveinal space to the green midrib without secondary veins.

Foliar spotting may be a result of herbicide spray drift. Also, burn may occur where cupped foliage maintains direct contact between herbicide spray droplets or granules on plant foliage. It is essential that any herbicide residue be washed off the foliage of nontarget plants promptly after application.

Overall necrosis, or death of tissue, is caused by a number of products and can occur in advanced stages of herbicide poisoning due to gross misapplication of chemicals. This symptom is often an extension of the chlorosis and/or foliar spotting mentioned earlier.

Epinastic growth is foliage or stems that are abnormally twisted, cupped, or otherwise distorted. These symptoms often indicate some type of phenoxy herbicide damage. Chemicals of this type are root and shoot absorbed and can cause injury in several different ways. Spray drift, root uptake, and volatilization may all occur in this category. Symptoms are like those seen on dandelions or other weeds soon after application of a broadleaf weed killer to the lawn. Commonly grown woody plants in Oklahoma, such as redbud and grape, are two of many species very sensitive to minute amounts of phenoxy herbicides.

Whole Plant Symptoms. Some trees will show a spiralling injury pattern. In these cases, abnormal or dead growth spirals from the base to the top of the plant. This has been reported as a very distinct and obvious pattern indicating a root absorbed chemical. In other species, as much as half of the plant can be markedly affected, while the remainder appears healthy. This could be a sign that spray drift has occurred and the side of the tree affected was in the path of the wind-carried chemical. When one half of a tree or shrub has been affected by a herbicide, the symptoms often closely resemble those of vascular wilt diseases.

Many herbicide injuries mimic symptoms exhibited by a pathogen, insect, or abiotic stress. Proper diagnosis often requires a team approach that combines expertise from horticulturists, plant pathologists, and entomologists.

Steps in Avoiding Herbicide Injury in the Nursery or Landscape

1. Read the label and confer with your Extension educator for current pest control recommendations. Choose correct herbicides that least affect the plants and surrounding environment. Avoid using soil sterilants around ornamental plantings. Soil sterilants or selective herbicides applied at soil sterilant rates should not be used within the nursery or landscape. Never apply long lasting, high toxicity soil sterilants under new pavement or sidewalks. Tree roots from nearby species will eventually grow into the site and translocate the chemical throughout the plant. These trees will be severely injured or killed as a direct result of the chemical weed barrier applied. Purchase herbicides from nurseries or garden centers that are staffed by qualified individuals who can recommend the appropriate chemical control when necessary.
2. Calibrate application equipment before each use. See OSU Fact Sheet BAE-1216, Calibrating a Low Pressure Ground Sprayer.
3. Apply herbicides around desirable plants that are healthy and vigorously growing. Use caution around nontarget plants with thin or green bark. However, in some cases, dormant, nontarget species will be less susceptible.
4. Do not plant in sites suspected to be contaminated with herbicides. Any herbicide may be used successfully for several years on one or more nontarget species with little or no injury. Problems may arise, however, when plants are finally harvested from a field and the grower decides to plant a different crop or crops. A sufficient buildup of herbicide residue, capable of injuring or killing newly introduced species, may be present in the soil.
5. Avoid drift by applying herbicides on calm days. Strive to apply herbicides when the wind speed is 10 mph or less. When possible, use a coarse droplet spray applied at low pressure. Strive to use herbicides early in the morning when winds are likely to be calm. Excessive temperatures can also be avoided in the morning hours. Intense heat can cause phenoxy type herbicides to volatilize and injure nearby nontarget species. When available, choose herbicide formulations that pose the least risk of drift or other forms of contamination. For example a low volatile ester or amine type formulation of 2,4-D is appropriate when spraying around sensitive, broadleaf ornamentals. Follow this precaution even when plants are dormant. Buds are capable of absorbing phenoxy-type herbicides in sufficient amounts to produce distorted leaves.

   Nurseries are often located in rural areas close to agronomic enterprises. It is a good idea to plant nursery crops as far as possible from fields of grain or other agronomic species. Herbicides used in these operations are often broadleaf herbicides that can be injurious to broadleaf ornamentals, should they drift or volatilize over to the nursery. The nursery operator should discuss any concerns with the farmers.
6. Injury may occur to certain plants when herbicides are applied to liners that are not well rooted. This may be addressed on the chemical label.
7. Although excellent grass control herbicides are available, they also have the potential to injure some broadleaf species. They are not totally selective between grassy weeds and desirable broadleaves.
8. The presence of a nontarget species on a herbicide label may imply that it will not be injured by the chemical. Cultivars of that species, however, can sometimes differ drastically in their tolerance to any given herbicide. Always experiment with new cultivars by only treating a few plants to establish their tolerance to the herbicide.
9. Avoid applying herbicides at their highest labeled rates in soils low in organic matter. Less soil applied herbicide is required for proper weed control in soils low in organic matter. Unfortunately, a smaller margin of tolerance exists for desirable plants growing in these soils. In general, Oklahoma soils are low in organic matter.
10. Avoid water contamination. Note nearby water sources that are potential targets for drift or runoff. Not only can water spread herbicide damage to nearby plants, but fish deaths and injury to other aquatic life may occur.
11. Be aware of where roots of desired plants really exist. Remember that root grafts of like species are quite common. For example if one stump is “poisoned”, a nearby tree of the same species may also be killed. Phenoxy type herbicides, glyphosate, and ammonium sulfamate are capable of translocating long distances and injuring desirable plants. Additionally, herbicide damage frequently occurs when harmful chemicals are applied just outside the dripline. Roots extend far beyond the dripline of trees and often absorb these chemicals. Absorbing roots that translocate herbicides throughout ornamental trees and shrubs are located in the top few inches of soil. Lastly, use caution when treating suckers as the herbicide may translocate back to the “mother plant” causing injury.
12. Air circulation is imperative due to volatilization that may occur. Nursery stock, treated in a greenhouse, can be injured in a short amount of time before being placed outside with proper air circulation. This is why few herbicides are labeled for indoor use. They are not phytotoxic if proper ventilation is provided around treated plants.
13. Keep chemicals in their original containers. Never switch containers, since this can lead to accidental contamination and/or personal injury.
14. Chemicals should only be applied by conscientious, certified applicators who follow label directions. Violating the label in any fashion is against the law.
15. Keep records of chemicals used, date, rate, wind speed, temperature, humidity, etc. that can increase the impact on both target and nontarget species.
16. Be sure to follow label directions for excess chemical and empty container disposal.
17. Apply pesticides in the cooler time of day; avoid applications during hot periods.
18. Always label and dedicate a sprayer to herbicides only to avoid phytotoxicity.
19. Choose water-based pesticides over oil-based chemicals when possible. When drift occurs, water-based pesticides are less likely to injure nontarget plants.

Steps to Mitigate Herbicide Injury

Always try to determine the chemical that has been misapplied or drifted to nontarget plants. By doing so, county Extension personnel can better arrive at a solution to alleviate further damage. Also, knowing the chemical will allow the manufacturer to be contacted for instructions in handling the specific case. Check the surrounding area for tree and shrub injury. Commercial installations, power lines, etc. are all potential sources of contamination since soil sterilants are

often applied in these areas. When unrelated species all exhibit similar symptoms, one can be fairly confident that a disease or insect is not the primary causal agent. Most herbicides will not discriminate among broadleaf species like a pathogen (disease organism) or insect usually will. Nor will a large number of unrelated species all react similarly to other stresses such as over watering, under watering, heat stress, etc.

In many instances, it is difficult to determine what, if any, chemical is responsible for a rapid decline of plants. An inexpensive method to determine if a chemical has moved into an area follows:

1. Collect soil samples from affected areas or areas suspected to be contaminated before additional plantings. Research has shown that samples should be taken at depths of 20 to 24 inches. Sampling and testing are particularly important before planting where paved areas previously existed. Soil sterilants persist for many years under paved lots, sidewalks, etc.
2. Fill flower pots with the suspected soil and plant tomato and corn seed, or any other broadleaf and grass species that germinate easily. Also include pots of seeds in soil gathered far way from the suspected area of contamination to be sure that the lack of germination or seedling damage is due to chemical damage and not some other factor.
3. Do not discard the pots if seeds germinate. Instead, wait a few more days to be certain seedling growth continues. Seeds often germinate but seedlings then show distortion and die several days later in the presence of herbicide-contaminated soil.

These steps allow for a quick test but determining the specific chemical involves costly laboratory procedures. Should the corn grow and the broadleaf die, for example, a triazine-type chemical may be involved. When all plants die, a soil sterilant may be present or a selective herbicide was applied at an excessive, injurious rate.

There is no comprehensive laboratory test for discriminating among possible chemicals involved. Therefore, each potential chemical is tested for individually. Even if the specific chemical is not identified, there are several ways to minimize any additional harmful effects to plants.

Root Barriers

When it is determined that a tree is actively growing into a contaminated site, its roots must be severed from the chemical source in the soil. Creation of a root barrier with neoprene, vinyl or polyethylene will prevent translocation. Even a cement barrier will work. The barrier material must retain its integrity for a number of years and be inserted from the soil line to at least 30 inches deep.

Soil Removal

Small areas of contaminated soil should be removed and disposed of according to local ordinances. This is impractical in large areas, but is the only sure way to solve the problem.

Alternatives to Soil Removal

Larger areas of soil are treated successfully only after determining what chemical was applied. Phenoxy type herbicides may be diluted with large quantities of water. When soil sterilants are suspected, however, do not irrigate. The chemical could be further moved damaging additional trees and shrubs in its path. When chemicals are organically based, an activated charcoal may be effective in adsorbing the chemical and rendering it less harmful in the soil. Regardless of the product involved, it is a good idea to call the manufacturer. It is difficult to reverse contaminated soils under the best of conditions; therefore, prevention is paramount to ensure healthy plants in the landscape.

Extension educators will be better able to assist in detecting and remedying any herbicide contamination when they are well informed of the specific case. Try to present the following information to the agent:

- Provide the date or estimate when possible herbicide applications occurred. Discuss the rate and report all other chemical applications such as fertilizers, insecticides, fungicides, etc. and their respective rates and formulations.
- Calculate the time lapse between any chemical applications and first signs of injury in the nursery or landscape.
- Provide a list of specific plants affected.
- Submit samples of affected plants (leaves, twigs, etc. while they are still alive).
- Make observations and report any specific patterns of injury to the plants themselves and patterns of injury throughout the nursery or landscape.
- Take photographs when possible and note the date taken.
- Note weather patterns in past weeks that could have contributed to the problem.

Herbicides remain an important chemical tool in vegetation management for modern nurseries and landscapes. Chemical companies put considerable investments into efficacy, health, and phytotoxicity tests as well as other types of research before releasing a product for use. However, herbicides are designed for efficient use, often in low doses, with the assumption they will be used with reasonable care. Therefore, some of the latest herbicides will cause phytotoxicity in minute amounts. Besides plant injury, be aware of any wildlife that is potentially at risk.

Chemical weed control is usually criticized unjustly when nontarget plants are damaged. Application errors are normally the cause of widespread damage. Always read and re-read the label just before applying herbicides. If still in doubt, contact an Extension educator or chemical company representative for further information before applying herbicides. Application of herbicides in violation of the label makes the applicator liable for any injury to nontarget plants, people, wildlife, or the surrounding environment.

Additional Information

Derr, Jeffrey F. and Bonnie Lee Appleton. *Herbicide Injury to Trees and Shrubs: A Pictorial Guide to Symptom Diagnosis*. Blue Crab Press, Virginia Beach, 1989.

Feucht, James R. and Jack D. Butler. *Landscape Management*. "Planting and Maintenance of Trees, Shrubs and Turfgrasses." Van Nostrand Reinhold, New York, 1988.

Schnelle, Michael A., James R. Feucht, and James E. Klett. 1989. "Root Systems of Trees - Facts and Fallacies." *Journal of Arboriculture* 15(9): 201-205.

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